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EXAMINER	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/758,669	SAPP, MARKUS	
	Examiner	Art Unit	
	Hugh Jones	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on 18 September 2007.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-17,19-34,36-43 and 45 is/are pending in the application.

4a) Of the above claim(s) ______ is/are withdrawn from consideration.

5)☐ Claim(s) ______ is/are allowed.

6)☒ Claim(s) 1-17,19-34,36-43 and 45 is/are rejected.

7)☐ Claim(s) ______ is/are objected to.

8)☐ Claim(s) ______ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on 21 March 2007 is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. ______.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date 9/10/2007.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. ______.

5) ☐ Notice of Informal Patent Application

6) ☐ Other: ______.

DETAILED ACTION

1. Claims 1-17, 19-34, 36-43, 45 of U. S. Application 10/758,669, filed on 1/14/2004 are pending.

Information Disclosure Statement

2. Applicants are thanked for the IDS.

Claim Objections

3. Claims 1-17, 19-34, 36-43, 45 are objected to because of the following informalities: the claims refer to "simulating a string". However, it appears it would be more accurate to recite "simulating the behavior (or *movement*) of a string" Appropriate correction is required.

Double Patenting

4. The nonstatutory double patenting rejection is based on a judicially created doctrine grounded in public policy (a policy reflected in the statute) so as to prevent the unjustified or improper timewise extension of the "right to exclude" granted by a patent and to prevent possible harassment by multiple assignees. A nonstatutory obviousness-type double patenting rejection is appropriate where the conflicting claims are not identical, but at least one examined application claim is not patentably distinct from the reference claim(s) because the examined application claim is either anticipated by, or would have been obvious over, the reference claim(s). See, e.g., *In re Berg*, 140 F.3d 1428, 46 USPQ2d 1226 (Fed. Cir. 1998); *In re Goodman*, 11 F.3d 1046, 29 USPQ2d 2010 (Fed. Cir. 1993); *In re Longi*, 759 F.2d 887, 225 USPQ 645 (Fed. Cir. 1985); *In re Van Ornum*, 686 F.2d 937, 214 USPQ 761 (CCPA 1982); *In re Vogel*, 422 F.2d 438, 164 USPQ 619 (CCPA 1970); and *In re Thorington*, 418 F.2d 528, 163 USPQ 644 (CCPA 1969).

A timely filed terminal disclaimer in compliance with 37 CFR 1.321(c) or 1.321(d) may be used to overcome an actual or provisional rejection based on a nonstatutory double patenting ground provided the conflicting application or patent either is shown to be commonly owned with this application, or claims an invention made as a result of activities undertaken within the scope of a joint research agreement.

Effective January 1, 1994, a registered attorney or agent of record may sign a terminal disclaimer. A terminal disclaimer signed by the assignee must fully comply with 37 CFR 3.73(b).

5. **Claims 1-17, 19-34, 36-43, 45 are rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over patented claims 1-30 of U.S. Patent Application No. 10/949/464.** Claims **1-17, 19-34, 36-43, 45** are anticipated by claims 1-30 in that claims 1-30 contain all the limitations of claims **1-17, 19-34, 36-43, 45** of the instant application. Claims **1-17, 19-34, 36-43, 45** of the instant application therefore are not patentably distinct from claims 1-30 and as such are unpatentable for obviousness-type double patenting.

6. This is a provisional obviousness-type double patenting rejection.

7. Amended claim 1 of the instant application is:

> 1. (Currently Amended) A machine-implemented method ~~of simulating a string, the method~~ comprising:
>
> forming a first equation to model a movable end of a string of a musical instrument, the first equation relating an excursion in time of the movable end to ~~simulating~~ a force acting on the string, the force exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string;
>
> forming a wave equation that relates movement of the string in time to the excursion of the movable end~~force acting on the string~~; and
>
> simulating the string to cause generation of ~~generating~~ a sound ~~based on~~by evaluating the ~~movement described in~~first equation and the wave equation.

8. Amended claim 1 of 10/949,464 is:

> 1. (Currently Amended) A method, comprising: [[of]]
>
> simulating a string using a wave equation that relates movement of the string in time to force acting on the string, wherein the string has a longitudinal axis in a first direction and is moveable in a second direction orthogonal to the first direction, and the force acting on the string simulates a stream of a fluid medium flowing relative to the string in a direction having a component in a third direction orthogonal to both the first and second directions; and
>
> creating sounds using the wave equation.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

10. A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

11. Claims 1-17, 19-34, 36-43, 45 are rejected under 35 U.S.C. 102(b)/103 as being clearly anticipated by Sapp (inventor), or, *in the alternative*, under 35 U.S.C. 103(a) as obvious over Sapp in view of Chin.

12. The 102/103 rejection is made because it is inherent to take into account boundary conditions and external driving forces when *solving* the wave equation. *The Examiner is aware that the background refers to two immovable ends for the string; however, these are arbitrary* boundary conditions. *The equations in the claims are identical to those disclosed in the background.* The choice of boundary equations does not patentably limit the wave equation and merely depends upon the intended use of the "string" and its wave equation.

13. Sapp discloses (pp. 1-4 of the specification (background)) the *same exact equations* as claimed. The choice of boundary conditions constitutes an intended use. For examples, see equation 1 and claim 14:

The continuous wave differential equation for a stiff string with one degree of freedom is:

$$M\frac{\partial^2 y}{\partial t^2}=T\frac{\partial^2 y}{\partial x^2}-S\frac{\partial^4 y}{\partial x^4}+L_T\frac{\partial^3 y}{\partial x^2\partial t}-L_S\frac{\partial^5 y}{\partial x^4\partial t}-L_r\frac{\partial y}{\partial t}+F(x,t)$$

14. (Original) A method according to claim 5, wherein the wave equation is an approximation of the continuous wave equation

$$M\frac{\partial^2 y}{\partial t^2} = T\frac{\partial^2 y}{\partial x^2} - S\frac{\partial^4 y}{\partial x^4} + L_T\frac{\partial^3 y}{\partial x^2 \partial t} - L_S\frac{\partial^5 y}{\partial x^4 \partial t} - L_V\frac{\partial y}{\partial t} + F(x,t)$$

in which:

In another example, see equation 2 and claim 15:

y[n+1, j] = (y[n, j-2] c1 + y[n, j-1] c2 + y[n, j] c3 + y[n, j+1] c2 +
y[n, j+2] c1 + y[n-1, j-2] c4 + y[n-1, j-1] c5 + y[n-1, j] c6 +
y[n-1, j+1] c5 + y[n-1, j+2] c4) / M[j]
+ 2y[n, j] + F[n, j]/M[j]

........(Equation 2)

in which:

y[n, j] denotes the excursion of discrete element j in the y-direction at time n;
y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;
y[n, j+1] denotes the excursion of discrete element j+1 in the y-direction at time n;

15. (Original) A method according to claim 14, wherein the approximation of the continuous wave equation is the discrete recursion formula:

y[n+1, j] = (y[n, j-2]·c1 + y[n, j-1]·c2 + y[n, j]·c3 + y[n, j+1]·c2 +
y[n, j+2]·c1 + y[n-1, j-2]·c4 + y[n-1, j-1]·c5 + y[n-1, j]·c6 + y[n1, j+1]·c5 + y[n-1, j+2]·c4) / M[j] + 2y[n, j] + F[n, j]/M[j]

in which:

dx = 1;
dt = 1;
y[n, j] denotes the excursion of discrete element j in the y-direction at time n;
y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;

In yet another example, see page 3 and claim 16:

More specifically, coefficients c1 to c6 can be calculated as follows:

c1 = -(S + Ls);
c2 = T + 4S + Lt +4Ls;
c3 = -(2T +6S + Lv + 2Lt + 6Ls);
c4 = Ls;
c5 = -(Lt + 4Ls); and
c6 = Lv +2Lt +6Ls

16. (Currently Amended) A method according to claim 15, wherein

$c1 = -(S + Ls);$

$c2 = T + 4S + Lt + 4Ls;$

$c3 = -(2T + 6S + Lv + 2Lt + 6Ls);$

$c4 = Ls;$

$c5 = -(Lt + 4Ls);$ and

$c6 = Lv + 2Lt + 6Ls.$

14. In the alternative, Sapp discloses all limitations other than the boundary conditions and external forces (such as recited in claim 2, for example).

15. Chin discloses numerical modeling of a towed cable. Inherently, in a towed body arrangement, the cable is constrained at one end and not constrained at the other end. There are boundary and initial conditions as well as driving forces corresponding to the wave problem disclosed in Chin.

16. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Sapp with Chin because they are both directed to numerical modeling of a "string" subject to longitudinal forces. Furthermore, towed cable modeling would constitute an intended and obvious use for the Sapp teaching. In modeling such an intended use, it would be inherent to constrain the "string" at one end and not at the other end. Furthermore, a recitation of the intended use of the claimed invention (using the wave equation (hundreds of years old) to model strings in musical instruments) must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

17. With respect to generating sound, Applicants admit:

17

There are many different ways in which the simulated vibration of the string can be used to create sound. For example, the force that the string applies to the right-hand support 20 can be calculated. This simulates the way a violin or acoustic guitar works in terms of sound radiation. Another way is to simulate an electromagnetic pick-up such as that used for an electric guitar by taking into account only the vibration of one element or a weighted sum of the vibrations of several neighbouring elements. Such methods are well known in the art and need not be described further.

and (page 1)

It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.

There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

Clearly, the point of musical instruments is for the generation of sound.

Claim Rejections - 35 USC § 103

18. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

19. The factual inquiries set forth in *Graham* **v.** *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.

3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

20. Claims 1-17, 19-34, 36-43, 45 are rejected under 35 U.S.C. § 103(a) as being unpatentable over Chin et al. (of record) in view of Applicant's Own Admission.

21. Chin et al. discloses numerical modeling of a towed cable,

Abstract

In this paper, the motion of a body towed by an aircraft on a long thin elastic cable is modelled. The motion of the cable is described by a system of partial differential equations, and a six degree of freedom model used for the towed body. The partial differential equations governing the motion of the cable-body system are solved numerically

including:

forming a first equation to model a movable end of a string of a musical instrument, the first equation relating an excursion in time of the movable end to a force acting on the string, the force exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string (section 2 "mathematical model"; section 3 "numerical scheme") flowing in a direction that has a component along a longitudinal axis of the string (title, fig. 1);

forming a wave equation that relates movement of the string in time to the excursion of the movable end (that's the definition of the wave equation; section 2 "mathematical model"; section 3 "numerical scheme");

simulating the string to cause generation a sound by evaluating the first equation and the wave equation (that's the definition of the wave equation; section 2 "mathematical model"; section 3 "numerical scheme").

and wherein

the simulated string is supported between two supports and is aligned at rest in a first direction between the two supports (fig. 1; Chin allows for unconstrained motion at the free end. However, this teaches Applicant's invention and extends it to three dimensions);

a first of the two supports allows movement in a second direction orthogonal to the first direction and a second of the two supports does not allow movement (the supports are merely boundary conditions for the string; fig. 1; Chin allows for unconstrained motion at the free end. However, this teaches Applicant's invention and extends it to three dimensions); and

the string is caused from rest to vibrate in a plane, which includes the first and second directions, by turbulence in the fluid flow causing the stream of fluid medium to exert a pressure on the string in the second direction (section 2 "mathematical model"; section 3 "numerical scheme"), wherein:

movement of the string out of alignment with the first direction causes the stream of fluid medium flowing in the first direction to exert the force on the string in the second direction (section 2 "mathematical model"; section 3 "numerical scheme"), wherein:

the string is caused to vibrate in a plane, which includes the first and second directions, by the stream of fluid medium flowing in a direction having a component in the second direction (section 2 "mathematical model"; section 3 "numerical scheme"), wherein:

the simulated string is supported between two supports aligned in an x-direction (section 2 "mathematical model"; section 3 "numerical scheme");

a first of the two supports allows movement in a y-direction orthogonal to the x-direction and a second of the two supports does not allow movement (section 2 "mathematical model"; section 3 "numerical scheme").

20. Chin et al. does not expressly disclose use of the wave equation to produce a sound from a musical instrument.

21. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Chin et al. to produce sound because Applicants have admitted that it has been done and that it is well known to do so (page 1):

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.

22. Furthermore, Applicants have admitted (response of 3/21/2007):

> art. It is also well known in the art that a sound synthesis technique uses equations and algorithms to simulate a physical source (e.g., a string) of sound (see, e.g., http://en.wikipedia.org/wiki/Physical_modelling_synthesis). The exact process of sound synthesis is an implementation detail that can vary from one embodiment to anther and is understood by persons of skill in the art. Thus, independent claims 1, 19 and 36 with

Furthermore, it is inherent and well known that the wave equation describes the behavior of strings in stringed instruments.

23. Chin et al. further does not expressly disclose the equations as exactly recited.

24. The specification discloses (pp. 1-4 of the specification (background)) the same exact equations as claimed.

25. It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Chin et al. to include the discretized form of the wave equation because Applicants admit that they can be used to approximate the continuous wave equation and are used to implement the solution on a computer. Such approximation would simplify computations. Furthermore, it has generally been recognized that merely providing an automatic means to replace a manual activity which accomplishes the same result is not sufficient to distinguish over the prior art, *In re Venner*, 262 F.2d 91, 95, 120 USPQ 193, 194 (CCPA 1958). In this case, merely solving the wave equation for a string on a computer, wherein the steps are routinely performed as a part of known practices in the art (the equation is hundreds of years old), is not novel or nonobvious.

26. Furthermore, a recitation of the intended use of the claimed invention (using the wave equation (hundreds of years old) to model strings in musical instruments) must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

27. With respect to generating sound, Applicants admit:

17

There are many different ways in which the simulated vibration of the string can be used to create sound. For example, the force that the string applies to the right-hand support 20 can be calculated. This simulates the way a violin or acoustic guitar works in terms of sound radiation. Another way is to simulate an electromagnetic pick-up such as that used for an electric guitar by taking into account only the vibration of one element or a weighted sum of the vibrations of several neighbouring elements. Such methods are well known in the art and need not be described further.

and (page 1)

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.

> There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

28. It would have also been obvious to a person of ordinary skill in the art at the time of the invention to use the wave equation to model musical instruments, including those which may include longitudinal vibrations, because it is recognized that use of a known technique (namely use of wave equation to model movement of a string) to improve a similar apparatus (*analyzing a string with longitudinal vibrations on a stringed instrument is mathematically identical to the problem being analyzed in Chin*) in the same way is not sufficient to distinguish over the prior art. Note page 1 of the specification:

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.

> There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

29. One of ordinary skill in the art could have applied the known "improvement" technique in the same way to the "base" device and the results would have been predictable to one of ordinary skill in the art.

30. Applicants have not invented the wave equations, and have merely applied a known technique (analysis of the wave equation on a computer) to improve a stringed apparatus in the same way. Page 1:

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.
>
> There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

The improvement is nothing more than the predictable use of known techniques to the prior art elements.

31. It would have been obvious to one of ordinary skill in the art at the time of the invention that a method of enhancing a particular class of apparatus was made part of the ordinary capabilities of one skilled in the art based upon the teaching of such improvement in other situations. One attempting to solve the wave equation for a string on a stringed instrument would have naturally searched the Internet to see whether there is a known technique to solve the equation. See page 1 of the specification:

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.
>
> There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

32. One of ordinary skill in the art would have been capable of applying this known method of analyzing the behavior of strings in the prior art and the results would have been predictable to one of ordinary skill in the art. The Supreme Court in KSR noted that "if the actual application of the technique would have been beyond the skill of one of ordinary skill in the art, then using the technique would not have been obvious."

33. Applicants have admitted that the problem was known in the art, and that analysis of the wave equation was commonly used to solve the problem.

(page 1)

> It is well known that the oscillations of a vibrating string can be modelled and the results converted by into sound. Thus, the vibration of each of the strings of a stringed instrument can be modelled by a sound synthesiser.
>
> There are several possible approaches to modelling a vibrating string, for example for use in sound synthesis. One such approach is to describe the modelled string by means of a differential equation, which can then be solved numerically by means of a standard iterative method using a computer. Thus, the wave equation of the modelled vibrating string is solved by iterative successive approximation, as discussed in "Synthesizing Musical Sounds by Solving the Wave Equation for Vibrating Objects": L Hiller and P Ruiz; Journal Audio Engineering Society, 1971, Vol. 19, pp 462-470 (Part I) and 542-551 (Part II). This iterative

KSR said that "[w]hen there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. ... In that instance the fact that a combination was obvious to try might show that it was obvious...." The fact that applicants as well as The art use the wave equation to solve the same type of physical behavior (longitudinal oscillations on a string), demonstrates that there are a finite number of predictable solutions.

Response to Arguments

34. Applicant's arguments, filed 9/18/2007, have been carefully considered and are not persuasive.

35. Applicants are thanked for the IDS.

36. Applicants argue:

> **II. Claims Rejected Under35 U.S.C. §101**
>
> Claims 1-17, 19-34, 36-43 and 45 stand rejected under 35 U.S.C. §101 as being directed to nonstatutory subject matter. Applicant amends independent Claims 1, 19 and 36 to remove "simulating a string" from the preamble and to add "a musical instrument" in the body of these claims. The amendments are made to more clearly point out that the string of a musical instrument is simulated to cause the generation of a sound, or equations that model the string of a musical instrument are evaluated to generate a sound. The generation of a sound is a useful, tangible and concrete result. Accordingly, withdrawal of the §101 rejection is respectfully rejected.

37. The 101 rejections are withdrawn in view of the amendment and Applicant's remarks, wherein, as argued, the claims are now directed to simulating/modeling musical instruments and producing a tangible sound.

38. It should be pointed out that merely providing for a sound after the simulation of the wave equation by itself would not be sufficient overcome the 101 rejection. The claim, as a whole, would still directed to an abstract idea, namely solving the wave equation of a moving string, *even if the claim called for physically generating a sound*. It is inherent that a string moving in air makes a sound. Simulating a string moving in air, including the corresponding sound, is a simulation of the *abstract idea* itself. Furthermore merely implementing the claimed invention on hardware, including a speaker, would not be sufficient overcome the 101 rejection.

> The Supreme Court has stated that "[p]henomena of nature, though just discovered, mental processes, and <u>abstract intellectual concepts</u> are not patentable, as they are the basic tools of scientific and technological work." <u>Benson</u>, 409 U.S. at 67 (emphasis added). In <u>Flook</u> the patentee argued that his claims did not seek to patent an abstract idea (an algorithm) because they were limited to a practical application of that idea—updating "alarm limits" for catalytic chemical conversion of hydrocarbons. 437 U.S. at 586, 589-90. The Court rejected the notion that mere recitation of a practical application of an abstract idea makes it patentable, *concluding that "[a] competent draftsman could <u>attach some form of post-solution activity to almost any mathematical formula</u>."* <u>Id.</u> at 590. Since all other features of the process were well-known, including "the use of computers for 'automatic monitoring-alarming,'" the Court construed the application as "simply provid[ing] a new and presumably better method for calculating alarm limit values." <u>Id.</u> at 594-95." In re Comiskey (CAFC 2006-1286) at 19.
>
> The Court held the application unpatentable because "if a claim [as a whole] is directed essentially to a method of calculating, using a mathematical formula, even if the solution is for a specific purpose, the claimed method is nonstatutory." 437 U.S. at 595

(quoting In re Richman, 563 F.2d 1026, 1030 (CCPA 1977)." Comiskey at 20.

39. However, the claims as a whole are directed to the simulation of musical instruments and producing a tangible sound. The 101 rejections are therefore withdrawn.

40. Applicants argue:

> **III. Double Patenting Rejection**
>
> Claims 1-17, 19-34, 36-43 and 45 stand provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over claims 1-30 of Applicant's co-pending U.S. Patent Application No. 10/949,464.
>
> Applicant submits that the above amendments to independent Claims 1, 19 and 36 obviate the Examiner's rejection. The conflicting co-pending application and the current application include distinct features, e.g., the first equation that models a movable end of a string of a musical instrument. Thus, withdrawal of the double patenting rejection is respectfully requested.
>
> However, Applicant reserves the opportunity to file any appropriate response (e.g., a terminal disclaimer) in the event that the pending claims are otherwise allowable.

41. Applicant's arguments are not persuasive. Merely calculating the wave equation for a string and using the results in the context of modeling a musical instrument constitutes an obvious application of the standard analysis of the wave equation. The "first equation" is not recited, but *appears* to constitute nothing more than the external driving force on the string (note, the string would not move without a driving force). In any case, the "first equation", itself, has only been broadly defined and is not actually recited in the claims. It is not possible to properly consider Applicant's argument because it is unclear what specific feature is alleged to be lacking in the art.

Amended claim 1:

1. (Currently Amended) A machine-implemented method ~~of simulating a string, the method~~ comprising:

forming a first equation to model a movable end of a string of a musical instrument, the first equation relating an excursion in time of the movable end to ~~simulating~~ a force acting on the string, the force exerted by a simulated stream of a fluid medium flowing in a direction that has a component along a longitudinal axis of the string;

forming a wave equation that relates movement of the string in time to the excursion of the movable end~~force acting on the string~~; and

simulating the string to cause generation of ~~generating~~ a sound ~~based on~~by evaluating the ~~movement described in~~first equation and the wave equation.

42. Regardless, the "moveable end" feature is still recited in the co-pending claims. Amended claim 1 of 10/949,464 is:

1. (Currently Amended) A method, comprising: [[of]]

simulating a string using a wave equation that relates movement of the string in time to force acting on the string, wherein the string has a longitudinal axis in a first direction and is moveable in a second direction orthogonal to the first direction, and the force acting on the string simulates a stream of a fluid medium flowing relative to the string in a direction having a component in a third direction orthogonal to both the first and second directions; and

creating sounds using the wave equation.

43. Applicants argue:

The Examiner indicates in the Final Office Action on page 8 that the equations in the claims are identical to those disclosed in the background of Applicant's specification. The background includes two equations. Equation 1 describes a string with the assumption that the string is rigidly supported at each end (page 2, lines 3-4). Equation 2 is an approximation of equation 1. There is no indication in the background that a first equation is formed to model a movable end of a string. An embodiment of the first equation is provided at pages 10-11 of the specification. The recited first equation is different from those equations described in the background and is, therefore, not a boundary condition of those equations in the background.

44. As stated in the last office action, t*he Examiner is aware that the background refers to two immovable ends for the string; however, these are arbitrary* boundary conditions. *The equations in the claims are* *<u>identical</u>* *to those disclosed in the background.* The choice of boundary equations does not

patentably distinguish over the wave equation and depends upon the intended use of the "string" and its wave equation.

45. Applicants have not invented a new wave equation, but merely used the wave equation and various initial and boundary conditions for a particular intended use.

46 Sapp discloses (pp. 1-4 of the specification (background)) the ***same exact equations*** as claimed. The choice of boundary conditions constitutes an intended use. For examples, see equation 1 and claim 14:

The continuous wave differential equation for a stiff string with one degree of freedom is:

$$M\frac{\partial^2 y}{\partial t^2} = T\frac{\partial^2 y}{\partial x^2} - S\frac{\partial^4 y}{\partial x^4} + L_T\frac{\partial^3 y}{\partial x^2 \partial t} - L_S\frac{\partial^5 y}{\partial x^4 \partial t} - L_V\frac{\partial y}{\partial t} + F(x,t)$$

14. (Original) A method according to claim 5, wherein the wave equation is an approximation of the continuous wave equation

$$M\frac{\partial^2 y}{\partial t^2} = T\frac{\partial^2 y}{\partial x^2} - S\frac{\partial^4 y}{\partial x^4} + L_T\frac{\partial^3 y}{\partial x^2 \partial t} - L_S\frac{\partial^5 y}{\partial x^4 \partial t} - L_V\frac{\partial y}{\partial t} + F(x,t)$$

in which:

In another example, see equation 2 and claim 15:

y[n+1, j] = (y[n, j-2] c1 + y[n, j-1] c2 + y[n, j] c3 + y[n, j+1] c2 +
y[n, j+2] c1 + y[n-1, j-2] c4 + y[n-1, j-1] c5 + y[n-1, j] c6 +
y[n-1, j+1] c5 + y[n-1, j+2] c4) / M[j]
+ 2y[n, j] + F[n, j]/M[j]

........(Equation 2)

in which:

y[n, j] denotes the excursion of discrete element j in the y-direction at time n;
y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;
y[n, j+1] denotes the excursion of discrete element j+1 in the y-direction at time n;

15. (Original) A method according to claim 14, wherein the approximation of the continuous wave equation is the discrete recursion formula:

y[n+1, j] = (y[n, j-2]·c1 + y[n, j-1]·c2 + y[n, j]·c3 + y[n, j+1]·c2 + y[n, j+2]·c1 + y[n-1, j-2]·c4 + y[n-1, j-1]·c5 + y[n-1, j]·c6 + y[n1, j+1]·c5 + y[n-1, j+2]·c4) / M[j] + 2y[n, j] + F[n, j]/M[j]

in which:

dx = 1;
dt = 1;
y[n, j] denotes the excursion of discrete element j in the y-direction at time n;
y[n+1, j] denotes the excursion of discrete element j in the y-direction at time n+1;

In yet another example, see page 3 and claim 16:

More specifically, coefficients c1 to c6 can be calculated as follows:

c1 = -(S + Ls);
c2 = T + 4S + Lt +4Ls;
c3 = -(2T +6S + Lv + 2Lt + 6Ls);
c4 = Ls;
c5 = -(Lt + 4Ls); and
c6 = Lv +2Lt +6Ls

16. (Currently Amended) A method according to claim 15, wherein

c1 = -(S + Ls);
c2 = T + 4S + Lt +4Ls;
c3 = -(2T +6S + Lv + 2Lt + 6Ls);
c4 = Ls;
c5 = -(Lt + 4Ls); and
c6 = Lv +2Lt +6Ls.

47. Applicants argue:

Chin does not supply the missing elements. Chin discloses numerical modeling of a body towed by an airplane with a cable. However, Chin does not disclose the use of a first equation, which is different from the wave equation, to model a movable end of a string. Moreover, Chin is not analogous art. The model for the towed cable and body is not related to a string of a musical instrument, and operates in an environment totally different from the string of a musical instrument. Thus, Claim 1 and its dependent claims are neither anticipated by Sapp nor obvious over Sapp in view of Chin.

48. In response to this argument, a recitation of the intended use of the claimed invention (using the wave equation (hundreds of years old) to model strings in musical instruments) must result in a structural difference between the claimed invention and the prior art in order to patentably distinguish the claimed invention from the prior art. If the prior art structure is capable of performing the intended use, then it meets the claim.

49. Applicants argue that the art is “non analogous”. However, *analyzing a string with longitudinal vibrations on a stringed instrument is mathematically identical to the problem being analyzed in Chin.*

50. It is noted that if the application of the wave equation as applied to a particular problem (as defined by the particular driving forces and boundary conditions) is patentable, then any equation as applied to any particular problem would also be patentable - clearly that is not the case.

Conclusion

51. Any inquiry concerning this communication or earlier communications from the examiner should be:

directed to: Dr. Hugh Jones telephone number (571) 272-3781,

Monday-Thursday 0830 to 0700 ET,

or

the examiner's supervisor, Kamini Shah, telephone number (571) 272-2279.
Any inquiry of a general nature or relating to the status of this application should be directed to the Group receptionist, telephone number (703) 305-3900.

mailed to:

Commissioner of Patents and Trademarks

Washington, D.C. 20231

or faxed to:

(703) 308-9051 (for formal communications intended for entry)

or (703) 308-1396 (for informal or draft communications, please label *PROPOSED* or *DRAFT*).

Dr. Hugh Jones

Primary Patent Examiner

September 25, 2007

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